



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

COVID-19 in Children: An Epidemiology Study from China

Evelyn Wang, MD, and Kanwaljit Brar, MD *Denver, Colo*

Practice Options from Beyond Our Pages focuses on identifying, critiquing, and placing into context research studies published in other journals that have the potential to change our clinical practices. It is written by Allergy-Immunology Fellows partnered with faculty members, and does not require an invitation for submission. This feature is coordinated by Editorial Board members Matthew Rank, MD and Julie Wang, MD.

REFERENCE

Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. *Pediatrics* 2020;145:e20200702.

BACKGROUND

In December 2019, several mysterious pneumonia cases emerged in Wuhan, Hubei province, China. In January 2020, a novel enveloped RNA coronavirus was identified as the cause, and by January 7, 2020, it was named by the World Health Organization (WHO) as 2019 novel coronavirus (2019-nCoV). By early-April 2020, the virus has spread widely across the world with over 1.5 million confirmed cases, which are increasing daily. The WHO has declared a public health emergency.¹ Despite worldwide spread, the epidemiological and clinical patterns of 2019-nCoV among children were initially unclear. Recently, public health officials announced the first death of an infant with coronavirus disease 2019 (COVID-19) in Cook County, Illinois, making identification of the features of COVID-19 in children of paramount importance. As such, we wish to present the findings of the largest retrospective study thus far of epidemiologic characteristics of 2143 pediatric patients with COVID-19.²

METHODS

Retrospective data from an electronic master database of children less than 18 years reported to the Chinese Center for Disease Control and Prevention from January 16 to February 8, 2020, were included for analysis. Most children originated from Hubei province, but there was significant disease spread to surrounding provinces. Children were selected if they were exposed to a COVID-19 case within the last 2 weeks or lived in an epidemic area (ie, Hubei province) or community where COVID-19 cases were reported. In addition, they were also included if they lived in a nonepidemic area where

COVID-19 cases were not reported, but had 2 of the following conditions: (1) clinical findings defined as fever, upper respiratory infection (URI) symptoms, gastrointestinal (GI) symptoms, fatigue; (2) laboratory findings of leukopenia, lymphopenia, increased C-reactive protein; and (3) abnormal chest X-ray findings (unspecified). Confirmed cases were confirmed with real-time polymerase chain reaction of nasal and pharyngeal swab specimens or blood samples. Patients could also be confirmed with genetic sequencing of respiratory tract or blood samples. The patients who were not confirmed, but had been excluded from influenza and other common respiratory infections were labeled as suspected diagnosis. Patients were further stratified by severity into asymptomatic, mild, moderate, severe, and critical (see [Table I](#)), based on clinical and examination findings, and associated complications.²

RESULTS

Two thousand one hundred and forty-three total pediatric cases were identified. Sixty-six percent (66%) of cases were suspected, and 34% were confirmed. Ninety-four (4.4%) of the patients were asymptomatic, 1091 (50.9%) were mild, 831 (38.8%) were moderate, 112 (5.2%) were severe, and 13 (0.6%) were critical. All of the 94 asymptomatic patients without clinical symptoms and normal chest imaging were confirmed. Of the 1091 mild patients, 315 were confirmed and 776 were suspected. These patients had URI symptoms including cough, sore throat, runny nose, sneezing, fever, and fatigue. On physical examination (PE), they had pharyngeal findings but no auscultatory abnormalities. Notably, some of these cases had *no fever* and only GI symptoms, such as nausea, vomiting, abdominal pain, and diarrhea. Of the 831 moderate patients, 300 were confirmed and 513 were suspected. These patients had pneumonia, frequent fever, and cough (mostly dry cough followed by a productive cough). PE revealed wheezing, though no hypoxemia or shortness of breath.

A subset of moderate patients had no clinical symptoms, but had positive chest computed tomography (CT) showing “lung lesions.” Of the 112 severe patients, 18 were confirmed and 94 were suspected. These patients had continued fever, cough, and GI symptoms around 1 week of disease progression with severe respiratory findings of dyspnea, central cyanosis, and hypoxemia. Of the 13 critical patients, 3 were confirmed and 10 were suspected. These patients had acute respiratory distress syndrome or other organ dysfunction including respiratory failure, shock, encephalopathy, myocardial injury or heart failure, coagulation dysfunction, and acute kidney injury. There were more males (56.6%) than females (43.4%), though this was not statistically significant. Of the 125 severe and critical cases,

Department of Pediatrics, National Jewish Health, Denver, ColoDepartment of Pediatrics, National Jewish Health, Denver, Colo

No funding was received for this work.

Conflicts of interest: The authors declare that they have no relevant conflicts of interest.

Received for publication April 5, 2020; revised April 12, 2020; accepted for publication April 14, 2020.

Available online April 21, 2020.

Corresponding author: Evelyn Wang, MD, Department of Pediatrics, National Jewish Health, 1400 Jackson St K830, Denver, CO 8020. E-mail: wangevelyn@njhealth.org.

2213-2198

<https://doi.org/10.1016/j.jaip.2020.04.024>

TABLE I. Breakdown of COVID-19 severity by age distribution²

Age	<1 y	1-5 y	6-10 y	11-15 y	>15 y	Total
Total	379	493	521	413	335	2143
Asymptomatic	7	15	30	27	15	94
SSx: none						
Imaging: normal						
Positive testing						
Mild	205	245	278	199	164	1091
SSx: URI sx, fever, fatigue, GI symptoms						
PE: throat findings, normal lung examination						
Moderate	127	197	191	170	146	831
SSx: PNA, frequent fever, prolonged cough						
PE: wheezing, SOB, normal O ₂ , ↑ HR						
Imaging: CT shows lung lesions						
Severe	33	34	22	14	9	112
SSx: fever, cough, GI symptoms around 1 wk						
PE: dyspnea, central cyanosis, O ₂ <92%						
Critical	7	2	0	3	1	13
SSx: ARDS, MI, HF, AKI respiratory failure, shock, encephalopathy, coagulation disorder						

AKI, Acute kidney injury; ARDS, acute respiratory distress syndrome; CT, computed tomography; GI, gastrointestinal; HF, heart failure; HR, heart rate; MI, myocardial injury; O₂, oxygen; PE, physical examination; PNA, pneumonia; SOB, shortness of breath; SSx, signs and symptoms; sx, symptoms; URI, upper respiratory infection.

40 (32%) were less than 12 months of age and 36 (28.8%) were less than 5 years (see Table I). Thus, 60% of the total severe and critical cases were in children less than 5. One child (age unspecified) died of unknown causes.

CRITICAL APPRAISAL

This study is the largest retrospective study to date on COVID-19 in children. It highlights the differences in symptomatology compared with adults, including occurrence of fever, which may occur in 88.7% of hospitalized adults compared with 41% to 56% of pediatric patients.³⁻⁵ Statistical analysis of clinical symptoms was not provided.

The study supports other recent findings about the mild nature of disease in children, as recent Centers for Disease Control and Prevention (CDC) data show that only 5.7% of pediatric patients were hospitalized compared with 10% of adults aged 18 to 64.^{2,3,5} Similarly, in another study of 6 COVID-19 hospitalized patients between 1 and 7 years old, all recovered after median hospitalization stay of 7.5 days, with only 1 child admitted to the pediatric intensive care unit.⁴ Interestingly, cough and pharyngitis were the most common symptoms in these patients. In another retrospective study of 9 hospitalized infants with confirmed COVID-19, none required intensive care, had severe complications, or needed mechanical ventilation.⁶ Because infants rely on caretakers, all were infected through household contacts.

There are a few limitations of this study; for example, testing was confirmed using pharyngeal, nasal, blood, or respiratory tract samples; anal swabs were not obtained, though viral fecal shedding has also been reported.^{7,8} The testing methods used confirmed that children may be asymptomatic carriers of the virus, though it was unclear if these asymptomatic children were identified because of history of exposure, or residence in the Hubei province through universal screening processes. It is additionally unclear if suspected patients had negative testing, or if suspected patients were not tested because of limitations in

testing supplies, or testing abilities in the pediatric population. Notably, there were more suspected than confirmed cases in the severe/critical categories, making it difficult to identify those at risk for a severe phenotype of this disease. It is possible that these severe and critical children may have had another disease process or infection.

RECOMMENDATION

Current retrospective studies from China would suggest that children seem to have a milder phenotype of COVID-19 than adults. In children, common presentation of COVID-19 may be asymptomatic, or limited to pharyngitis or cough, or only GI symptoms.² Approximately half of pediatric patients present with fever, far less frequent than adults, and providers should be aware of these differences from adult household contacts.^{9,10} In this study, some children had no clinical symptoms but positive chest CT findings, which were not specified; however, findings identified in other studies include ground glass opacities, local and bilateral patchy shadowing, interstitial abnormalities, and consolidation.^{5,11} Thus, radiographs play an important role in diagnostic workup of COVID-19. In addition, patients with more moderate findings may warrant a more extensive laboratory workup. Current CDC guidelines suggest testing only if having a risk factor plus clinical features, typically cough, lower respiratory symptoms, and fever. Consideration may be given to enhanced pediatric testing, as many infected children may be unidentified carriers, thus spreading the disease throughout the community.

Acknowledgments

E. Wang helped with creation of figures, drafting of the manuscript, and critical revision. She takes responsibility for the manuscript. She is a fellow-in-training. K. Brar helped with drafting of the manuscript and critical revision. She is a faculty member.

REFERENCES

1. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report - 83 [press release]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200412-sitrep-83-covid-19.pdf?sfvrsn=697ce98d_4. Accessed April 12, 2020.
2. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. *Pediatrics* 2020;145:e20200702.
3. Centers for Disease Control and Prevention. Coronavirus Disease 2019 in Children — United States, February 12–April 2, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:422-6.
4. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020;382:1708-20.
5. Lu X, Zhang L, Du H, Zhang J, Li YY, Qu J, et al. SARS-CoV-2 infection in children. *N Engl J Med* 2020;382:1663-5.
6. Liu W, Zhang Q, Chen J, Xiang R, Song H, Shu S, et al. Detection of COVID-19 in children in early January 2020 in Wuhan, China. *N Engl J Med* 2020;382:1370-1.
7. Wei M, Yuan J, Liu Y, Fu T, Yu X, Zhang ZJ. Novel coronavirus infection in hospitalized infants under 1 year of age in China. *JAMA* 2020;323:1313-4.
8. Xu Y, Li X, Zhu B, Liang H, Fang C, Gong Y, et al. Characteristics of pediatric SARS-CoV-2 infection and potential evidence for persistent fecal viral shedding. *Nat Med* 2020;26:502-5.
9. Cui Y, Tian M, Huang D, Wang X, Huang Y, Fan L, et al. A 55-day-old female infant infected with COVID 19: presenting with pneumonia, liver injury, and heart damage. *J Infect Dis* 2020;221:1775-81.
10. Zimmermann P, Curtis N. Coronavirus infections in children including COVID-19: An overview of the epidemiology, clinical features, diagnosis, treatment and prevention options in children. *Pediatr Infect Dis J* 2020;39:355-68.
11. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, et al. Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection. *Radiology* 2020;295:685-91.